

	Type	L #	Hits	Search Text	DBs	Time Stamp
1	BRS	L1	795	(borescope or endoscope) and ultraviolet	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:12
2	BRS	L2	10	1 and blue near LED	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:05
3	BRS	L3	219	1 and white near light	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:03
4	BRS	L4	86	3 and LED	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:03
5	BRS	L5	8	3 and blue near LED	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:04

	Type	L #	Hits	Search Text	DBs	Time Stamp
6	BRS	L6	353	1 and optical near fiber	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:12
7	BRS	L7	82	6 and eyepiece	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:12
8	BRS	L8	65	7 and flexible	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:07
9	BRS	L9	12	8 and LED	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:07
10	BRS	L10	51	borescope and ultraviolet	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:12

	Type	L #	Hits	Search Text	DBs	Time Stamp
11	BRS	L11	37	10 and optical near fiber	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:12
12	BRS	L12	3	11 and eyepiece	USPAT; US-PGP UB; EPO; JPO; DERWEN T; IBM_TD B	2002/12/04 11:13

US-PAT-NO: 5045936

DOCUMENT-IDENTIFIER: US 5045936 A

TITLE: Laser scanning imaging apparatus and method of ranging

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Such apparatus are well-known and are used as endoscopes to examine internal surfaces of, for example, human bodies and as borescopes to examine mechanical components such as engines, aero engines, and aircraft.

Throughout the specification we will refer to "light", "optical" and like expressions. It will be understood, however, that the present invention is not restricted to electromagnetic radiation of visible wavelengths, but may apply to other wavelengths such as infra-red and ultraviolet. The term "lens" used in the specification should also be understood to encompass groups of lens elements where appropriate.

An apparatus including optical apparatus for use as an endoscope or borescope illustrating a preferred embodiment of several aspects of the invention will now be described by way of example only and with reference to the accompanying drawings. Reference to the term "endoscope" should be understood to encompass the same apparatus used in non-medical uses as a borescope.

It has been found optimum to arrange that the overall cross-section of the input surface 26 of the optical fibres 12 is the same as the cross-sectional area of the projected beam 38 at the output lens assembly 23 during the ranging

operation and under these circumstances it has been found that as the focal plane 34 is moved back and forth (by relative movement of lenses 31 and 32) the modulation due to speckle in the signal detected by the photomultiplier 27 is at a maximum when the plane 34 coincides with the surface of the object 28.

The endoscope tube 11 has a proximal end 35 connected to a laser scanning head 39. A flexible single mode fibre optic link 51 connects a laser 14 to the laser scanning head 39, the link 51 comprising a single optical fibre which retains the coherence characteristics of the light carried.

The components of the zoom lens 52 may also be corrected for chromatic aberration in known manner if it is required to use more than one laser scanning frequency or if the endoscope tube is dual purpose in that it may also be used as part of a conventional endoscope by the attachment of an eyepiece to the proximal end of the endoscope tube 11.

In FIG. 17 the endoscope 160 includes an endoscope tube 11 having a distal end 36 including components corresponding to those of the apparatus of FIG. 4. The endoscope tube 11 has a proximal end 35 connected to a housing 161 having an eyepiece 162. The endoscope 160 is also connected to a source of white light 163 by means of a light guide 164. Light from the white light source 163 is passed into the housing 161 and along a fibre optic bundle 53 to emerge from window 54 so as to illuminate the object 28. Reflected light from the object 28 is received at the window 56 and reflected by means of prism 81 into the zoom lens 52. An image of the object is transferred to the eyepiece 162 by means of the optical relay 12 where it is directly viewed by an observer. The

zoom lens 52 is controlled by means of a control wire 57 extending into the housing 161 and connected to an actuator 165.

16. Apparatus as claimed in claim 11 wherein the scanning head is removably connected to the endoscope tube, the tube being connectable to an eyepiece for use in direct viewing through the optical system.